

CLAIMS:

1. An atomic layer deposition system comprising:
a process chamber;
a substrate holder provided within said process chamber, and configured to support a substrate;
a gas injection system configured to supply a first precursor and a second precursor to said process chamber; and
a controller configured to control said gas injection system to continuously flow said first precursor to said process chamber and to pulse said second precursor to said process chamber at a first time, said controller being configured to pulse a RF power to said substrate holder at a second time in order to sequentially deposit at least one monolayer on said substrate.
2. The system of claim 1, wherein a gas injection plate of said gas injection system is substantially parallel to a substrate receiving surface of said substrate holder, and wherein said gas injection plate is configured to introduce at least one of said first gas flow and said second gas flow into said process chamber in a direction substantially normal to said substrate receiving surface of said substrate holder.
3. The system of claim 1, wherein said controller is configured to provide a pulse width of said second gas flow that is substantially equivalent to a pulse width of said RF power pulse.
4. The system of claim 1, wherein said controller is configured to provide a pulse period of said second gas flow that is substantially equivalent to a pulse period of said RF power pulse.
5. The system of claim 1, wherein said controller is configured to provide a pulse duty cycle of said second gas flow that is substantially equivalent to a pulse duty cycle of said RF power pulse.

6. The system of claim 1, wherein said controller is configured to provide that said first time of said pulse of second gas flow substantially corresponds to said second time of said pulse of RF power.

7. The system of claim 1, wherein said controller is configured to provide that said first time of said pulse of second gas flow is offset from said second time of said pulse of RF power.

8. The system of claim 1, wherein said controller is configured to adjust a background pressure in said process chamber.

9. The system of claim 1, further comprising an oscillator coupled to said substrate holder for providing said RF power, said oscillator producing an RF signal.

10. The system of claim 9, further comprising an amplifier coupled to said oscillator.

11. The system of claim 10, wherein said amplifier is a linear amplifier.

12. The system of claim 10, further comprising an impedance match network connecting said amplifier to said substrate holder.

13. The system of claim 12, wherein said controller is connected to and configured to control said amplifier and said impedance match network.

14. The system of claim 10, further comprising a waveform generator configured to produce an input signal and coupled to said amplifier, wherein said RF signal is received by said amplifier and wherein said RF signal is subjected to amplitude modulation via said input signal received by said amplifier from said waveform generator.

15. The system of claim 14, wherein said input signal is a pulse waveform.

16. The system of claim 14, wherein said controller is connected to and configured to control said waveform generator.

17. The system of claim 1, said gas injection system comprising a first gas supply connected to a mass flow controller, and a second gas supply connected to a pulsed gas injection manifold.

18. The system of claim 17, wherein said pulsed gas injection manifold comprises a pressure regulator, a pulsed gas injection valve, and a gas distribution manifold.

19. The system of claim 17, said controller being connected to and configured to control said first gas supply, said mass flow controller, said second gas supply, and said pulsed gas injection manifold.

20. The system of claim 1, wherein said gas injection system is configured to supply a first precursor selected from the group consisting of WF_6 , $W(CO)_6$, $TaCl_5$, PDEAT (pentakis(diethylamido) tantalum), PEMAT (pentakis(ethylmethyldamido) tantalum), $TaBr_5$, TBTDET (t-butylimino tris(diethylamino) tantalum), molybdenum hexafluoride, $Cu(TMVS)(hfac)$, (Trimethylvinylsilyl) hexafluoroacetylacetonato Copper I, $CuCl$, $Zr(NO_3)_4$, $ZrCl_4$, $Hf(NO_3)_4$, $HfCl_4$, niobium pentachloride, zinc dichloride, $Si(NO_3)_4$, $SiCl_4$, dichlorosilane, $Ti(NO_3)_3$, $TiCl_4$, TiI_4 , tetrakis(diethylamino)titanium, tetrakis(dimethylamino)titanium, aluminum trichloride, trimethylaluminum, gallium nitrate, trimethylgallium, and Cr oxo-nitrate.

21. The system of claim 1, wherein said gas injection system is configured to supply a second precursor as at least one of H_2 , N_2 , O_2 , H_2O , NH_3 , or H_2O_2 .

22. The system of claim 1, wherein said first precursor further includes a carrier gas.

23. The system of claim 22, wherein said carrier gas includes a Noble gas.

24. The system of claim 1, wherein said second precursor further includes a carrier gas.

25. The system of claim 24, wherein said carrier gas includes a Noble gas.

26. A method of operating a plasma processing system in order to deposit a film on a substrate using atomic layer deposition (ALD), the method comprising the steps of:

adjusting a background pressure in a process chamber, wherein the background pressure is established by flowing a first gas flow of a first precursor using a gas injection system;

igniting a processing plasma in the process chamber;

pulsing a second gas flow of a second precursor using the gas injection system at a first time;

pulsing a RF power to a substrate holder at a second time; and

sequentially depositing at least one monolayer of said film using said first precursor and said second precursor.

27. The method according to claim 26, wherein the step of pulsing the second gas flow is performed for a predetermined pulse width.

28. The method according to claim 26, wherein the step of pulsing the second gas flow is performed for a predetermined pulse period.

29. The method according to claim 26, wherein the step of pulsing the second gas flow is performed to achieve a predetermined pulse duty cycle.

30. The method according to claim 26, wherein the step of pulsing the RF power is performed for a predetermined pulse width.

31. The method according to claim 26, wherein the step of pulsing the RF power is performed for a predetermined pulse period.

32. The method according to claim 26, wherein the step of pulsing the RF power is performed to achieve a predetermined pulse duty cycle.

33. The method according to claim 26, wherein the step of pulsing the second gas flow is performed for a first pulse width, and wherein the step of pulsing the RF power is performed for a second pulse width, said first pulse width being substantially equivalent to said second pulse width.

34. The method according to claim 26, wherein the step of pulsing the second gas flow is performed for a first pulse period, and wherein the step of pulsing the RF power is performed for a second pulse period, said first pulse period being substantially equivalent to said second pulse period.

35. The method according to claim 26, wherein the step of pulsing the second gas flow is performed to achieve a first pulse duty cycle, and wherein the step of pulsing the RF power is performed to achieve a second pulse duty cycle, said first pulse duty cycle being substantially equivalent to said second pulse duty cycle.

36. The method according to claim 26, wherein the first time of the pulse of second gas flow substantially corresponds to the second time of the pulse of RF power.

37. The method according to claim 26, wherein the first time of the pulse of second gas flow is offset from the second time of the pulse of RF power.

38. An atomic layer deposition system having a process chamber and substrate holder, the system comprising:

means for introducing a first gas flow to the process chamber to adjust a background pressure in the process chamber;

means for producing a plasma in the process chamber;
means for pulsing a second gas flow to the process chamber; and
means for pulsing RF power to said substrate holder.